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Iron Castings,

ARTICLE II.

(Written for Engineering News.)

To no one material probably have the industries of the world been so much indebted as to cast iron It can be readily shaped into largely diversified forms, and it possesses great strength in compression. Since the days of the first iron foundry on the banks of the Carron the progress has been very marked; without cast iron the steam engine would have remained a toy in the laboratory, while machinery generally would have continued in a weak and helpless childhood.

This metal is too well known to need a complete and necessarily lengthy description here, but the predominant characteristics may be briefly touched upon.—The inpression made on the mind of an observer when examining a recent fracture in a piece of cast iron is, that the material is made up of fine grains, more or less elongated in form, and that these grains are packed very close together sticking to each other by reason of some cementing property, or perhaps by adhesion, the grains or crystals being in contact with each other. The size of these grains, the color and shape vary considerably and afford a very good clue to the nature of the iron. A very close, small grained, white surface is obtained from a strong, brittle, hard iron; and a fine elongated grain, which feels like a "new file," with a blue grey color, accompanies a strong soft iron which has considerable elasticity and capacity for withstanding shocks. A mottled color with rounded grains denotes a weak uncertain material, and, generally, we may say,—that the hardness varies with the color, being greatest with the white and least with the blue grey; that the strength varies with the size of the grains, being greatest with the finer and least with the larger sized particles; and that the endurance or capacity for withstanding vibration and shock varies with the form of the grains, being greatest with the elongated and sharp edged grains and least with the rounded and smoother edged ones. The above are the general characteristics; but there are of course many striking exceptions, due to inherent qualities in the metal and in the ores from which it is made; and in fact the above must be considered as only generally true.

For convenience we will classify the products of the foundry into—

Castings for Machine and Engine work;

Castings for Engineering works, and for great strength with little ornamental effect;

Castings for ornamental purposes;

Castings for Architectural purposes where there is an attempt to combine strength and appearance;

Castings for Stoves and castings for Malleable Iron. Many combinations of these classes may be made.

For machine and engine work which has to be accurately fitted, and the pieces of which have to be turned, planed, bored or drilled with machine or hand tools, it is of great importance that the iron should be soft enough to work easily, and yet of sufficient strength to do the work required of it; for this class, "No. 1 Foundry," is the only reliable material. Such castings should be free from sand, with a thin skin, a free open grain, sharp edges and a blue grey color.

When the iron cools in the mold there is formed a skin of harder iron, and for these purposes the skin should not be hard nor extend very deeply into the body of the casting. When the casting is taken from the mold and is sufficiently cool to be handled, the first work is to clean off the sand which may adhere to the surface, and to remove the cores; then the "gates," "fins" and "scabs" have to be cut off with a cold chisel. In some foundries small castings are put in a "tumbling mill" to clean off the sand and then "pickled" in dilute sulphuric acid to soften the skin, but this is not so common in western foundries. Softness, uniformity and soundness of matesial are the great requisites for this class of work, and we know of many instances where, from a misplaced economy in buying cheap iron, the cost of labor on hard castings has been increased to many times the amount of the imagined saving.

In the preparation of castings for engineering works, where strength is the great desideratum, the sand having been cleaned off and the excrescences gotten rid of, the work is usually confined to facing the bearing surfaces, by planing, turning or by a multiple cutter, or by hand chipping. In any case the finishing labor is much less in proportion to the cost of the iron than it is in the preparation of work for engines and machinery, and the metal may be much harder than when needed for such purposes. The skin or harder portions should be as little broken as possible and a fine and sharp grained metal is employed, which may have a grey, or even greyish-white color. No's 2 & 3 Foundry iron are most suitable for such metal and, when mixed with good scrap, give very good results. The iron can be made so strong as to shrink very much and to endanger the casting by internal strains. In this class may be enumerated plain columns, lintels, beams, girders, drum curbs used for foundations, and pipes for water and gas, though these latter are specialties, and will require different treatment.

Among castings for ornamental purposes may be specified fences, posts, the beams used in the capitals of columns, and a great variety of small objects. The principal quality the metal should have is fluidity, to take the exact form of the mould; the pieces should be smooth on the surface and soft enough to work easily, as such pieces usually have to be drilled. Among the varieties of our classification we shall find the lintels and cornices used in architectural work, the bases of columns and of pilasters. The same kind of metal is needed as in ornamental work generally, but the softness is less important and the shrinkage more so.

Pilasters and columns used for architectural work are more or less ornate, and yet have to carry loads. The same iron is used for them as for engineering works, but the faces should be smoother, and the iron a little more fluid, in order that the casting may present a better appearance and require as little work in getting it ready for erection as possible. Where strength is important, as in cornices, spandrels, and moulded bases to columns, pieces which have been warped out of shape by shrinkage may be sawed or cut open and then, after being straightened, can be patched with plates of wrought iron secured with small holes to the back of the casting. Long cornices are made in sections and secured in the same way.

The term "stove castings" is applied not only to pieces for stoves but to any small work which is expected to come from the mould in a finished condition with smooth surfaces and without adherence of sand, and which has only to be drilled to be put together by bolts. They must be made of a highly fluid iron, and for stoves a cold-short metal is usually employed, they are often very hard and have a fine white grain which renders them hard to drill. This should be avoided if possible.

Malleable castings are a special industry and are scarcely in the range of the old-fashioned founder, and we shall not attempt to describe or define the irons, or the uses of this material.

The varieties of pig iron are so many and are changing so continually, that it is only by a long experience that "mixtures" for any desired kind of work can be properly and economically made, and many disappointments will be experienced, even by the oldest and most skillful foundry men, if the conditions of time and place be changed:

The use of cast iron as a building material will be considered in a future article although very little can be added to the literature already extant on that subject.

Printing Invention.

Two important inventions connected with the important art of printing have just been perfected,—one in England and one in this country,—which almost bid fair to be worthy of being recorded along with the triumphs of Guttenberg and Faust. The first is a machine for printing illustrated journals. It is on the cylinder principle, electro plates being curved in order to fit them to the drums or "turtles," so that the machine will be enabled to print almost as many impressions of engravings per hour as the inventor has hitherto printed impressions from mere type. It is expected that the introduction of the machine will entirely revolutionize the process of what is known as book printing. The second is a machine by which molten lead is instantly converted into type and arranged for the press. It consists principally of a revolving iron cylinder, described as somewhat resembling a good-sized garden roller, with a small bank of finger keys on top, while behind and almost concealed from view is a small tank of molten lead, heated by a gas burner beneath. The result is a stream of type pushed out steadily from one side, every letter perfect and exactly corresponding in its arrangement with the copy followed by the operator, ready for an impression in ink. The machine is said to occupy no more space than an ordinary compositor's stand, and to require no other supervision than that afforded by the compositor, who indicates the letters to be made and set by simply touching a key. The type made are in all respects identical with those now in use; and the machine, it is claimed, is capable of doing its work with such speed that the type are made and set at one half the cost of the method now in use, while the matter printed is better than the present printing, because the impression is from entirely new type When the type has been once used, either for the press or for stereotyping, it may be remelted and used with less expenditure, either of time or money, than would be required to distribute and set it again. The attempt to pick up type by machinery, so long persisted in, has been abandoned as impracticable, chiefly because type could not be made so durable as to withstand the constant and repeated handling by metallic substitutes for fingers. Another essential feature is that the machine being wholly automatic, casts and dresses the type, making it in all respects equal to that in ordinary use. It also places the type in position, so that it is ready to go on the press without further manipulation. The expensive fonts now in use are done away with by the new method. It is contemplated to engage without delay in the manufacture of these machines, whose average cost is estimated at about $500 each. The invention is declared at the United States patent office to be one of the most important of late years.—*Pittsburgh Commercial.*

R. M. Eddy, Proprietor of the Globe Foundry, 76 to 80 Illinois street of this city, is employing twenty men on full time. The products of the establishment consist of castings for machine and stationary engines, hoisting and general machinery, etc. He also makes a speciality of boiler fronts and castings for gas works.

The Metric System as Adapted to the Use of American Machine Shops.

BY WILLARD S. POPE, PREST. DETROIT BRIDGE AND IRON WORKS.

I am requested to state my opinion as to the propriety of the adoption of the metric system by machine shops and similar establishments. This confines me to the consideration of the linear measurements chiefly, and of small dimensions, viz.: feet and inches, as compared with the subdivisions of the metre.

The metric system is a very graceful and plausible theory. The ease and simplicity promised by the use of decimals is very attractive. The excellence lies upon the surface. It appeals instantly to every consciousness; and the impulse of all to whom it is explained is at once in its favor. The first wonder is that any other system could ever have been suggested; and the desire is almost instinctive that the old and cumbersome methods should be at once discarded and the new one adopted.

But in this, as in many other things, it is well to make haste slowly. The present arrangement has at least the prestige of antiquity. It is not entirely respectful to our forefathers to suddenly sweep away the system which they matured so long ago, and which has for so many years met their requirements and ours.

To explain why they devised and adopted it is not perhaps difficult. An inch is the ordinary length of the first joint of a man's middle finger; a foot is perhaps the length of the foot; a yard is the length of the leg, etc. So every man had constantly with him a scale of measurement that would give a tolerable approximation to the standard dimensions.

When necessity arose for closer measurements, of course more accurate and absolute scales were required, but the sub-division and the nomenclature remained unchanged.

It is now proposed to do away entirely with this system, and substitute another for it. In what respect is the new really better than the old?

The first essential of any standard of dimensions is that the unit of measurement should be fixed and absolute, and capable at all times of proof or rectification.

In the old system the unit is the yard; obtained now with absolute accuracy by the the length of a pendulum under certain definite conditions. In the new system it is the metre: a certain portion of the circumference of the earth.

Both are equally well defined; and in all the requirements of certainty and explicitness, one is as good as the other.

I think of no good reason why the metre should be substituted for the yard.

In the new system, from the metre, both up and down, decimals are used. In the old, from the yard we derive the foot, which has now become practically the general unit. This is cut up into inches, a sub-division which would appear clumsy and irrational, if we disregard its probable origin.

But however it may have originated, the fact is none the less true that a 12th is an awkward fraction. It has not the symmetry and facility and nimbleness that characterizes the 10th.

Greater labor and care is certainly demanded to acquire deftness in the use of the former than of the latter; still when the process has once become perfectly familiar it is not difficult to manage. But it is freely admitted that the decimal system is superior in simplicity and ease of manipulation and that a change to it would theoretically be a decided gain.

So much for the *theory* of the substitution. Let us now consider its economic practicability in constructive engineering.

The English measures are in universal use among English speaking people. Every one is familiar with them. All mechanics are trained to their use, and all machinery is constructed by and for them. Tables are formed in them; and, in short all data are based upon them. To change them is to change everything. It is more than change; it is revolution. All tools and machines are constructed with reference to the old system. Lathes and planers and drills register by inches; screws and nuts are cut with reference to inches; all the shapes of iron are made with reference to inches. It might appear at first that these need not be changed except in name; but a moment's reflection will show that the modification goes deeper than mere nomenclature.

A yard or a foot can be divided into inches without a remainder; but not so with a metre. A yard is 36 inches exactly, but a metre is 36 inches and a remainder.

Therefore a dimension in inches cannot be exactly expressed in decimals of a metre.

For instance, we have a tap for cutting nuts for a bolt 1¼ inches; 6 threads to the inch. How shall this be described in metric parlance? A tap for a bolt 3.1751676+ centimetres in diameter. This simple illustration is sufficient to show that absolute certainty is impossible, in any attempted combination of the two system. We cannot serve two masters.

The change, if made at all, must be complete add instantaneous. When the new system comes in, the old must go out. All tables, all standards, all registering tools and machines must be changed. The cost of changing taps and dies alone would be very large.

But this does not apply alone to shop tools, used for purposes of constructing new work. Work already done is equally affected.

An engine, made before the change needs repair. It was made by the old standards and gauges. Of course the new will not fit. A cylinder 14" needs a new piston. This must be 3.45561877+ decimetres in diameter. How shall this be described to the mechanic who is to turn it up on the lathe?

A 2" anchor bolt needs a new nut. How shall this be cut with the new taps? A pulley must be replaced on a 3" shaft. It must be bored out to 7.6204023+ centimetres. The man at the drill would stand aghast.

But this is not all. Men are affected as well as machinery. The infinite labor that has been expended in acquiring familiarity with the old processes is to be thrown away, and all is to start again *de novo*. This familiarity in each individual case was acquired in youth, when the mind is plastic and flexible and retentive. The new is to be acquired in mature life, when such attainments are far more difficult.

Apprentices learn their business, not much from books, but rather from the current practice of the shop; from the talk of the men; from constantly seeing things done. Their training is mainly imitative. They work with and among the older men and must become familiar with their practices and processes. Even the apprentices therefore, though they may enter the shop after the new system is adopted, will to a considerable extent inherit the difficulties besetting the journeymen in their efforts to translate the old method into the the new.

In short it is evident that, during at least the present generation, the old system could not be so far discarded and the new one adopted, but that there would be constantly and inevitably a jumble and a confusion of ideas and nomenclature that would be fatal to success and accuracy.

These are some of the reasons that incline me to the opinion that to adopt the metric system in our machine shops would be injudicious.

LETTER FROM W. B. FRANKLIN, COLT'S PATENT FIRE ARMS MAN'F'G. CO.

Dear Sir,—Your letter of the 7th inst., arrived during my absence, and I have not been able to answer it until now. I am inclined to think that should a law be enacted fixing the date at which the metric system of weights and measures must be used in the United States, it would at first produce a good deal of inconvenience in gun shops, where as a general thing the precise dimensions of gauges, taps, dies, etc., have been recorded by stamping them on some part of the piece. In working from drawings on which the dimensions are given in millimetres and decimals of the millimetre, the necessary tap or die would have to be searched for by having the dimensions translated into inches and eighths or multiples of eigths, and that one which comes nearest the required number of millimetres would be taken.

This inconvenience however would not be as great as at first sight it appears, in gun constructions. Drawings of new guns which are given to the workman to construct from are always made full size, and there are generally many cuts and shapes which require special tools made purposely for them. Indeed if it were required by the contract that the various screws about the gun should be of unusual dimensions special taps and dies would be made for them, the cost of which spread over a large number of guns would be trifling.

The calibre, and therefore the chamber, bore and rifling of a new gun, are apt to be different from those of any other gun, and there may not be a dimension or shape given in the drawings which would not require a special tool to work out. The workman therefore makes a perfect model from drawings, and special tools for making the gun in large quantities, and guages to keep the dimensions of the corresponding parts in each gun absolute by the same, are made from *this model*, so that so far as the manufacture of the guns afterwards in large quantities is concerned, it is entirely immaterial what was the unit of measure to which the drawing was made, provided the workman was furnished with a rule divided to that unit.

For instance were this company to make a contract with France for making arms the fact that the metre is the unit of measure would not make the slightest difference in price. The finished, sealed, model would be our guide, and the tools and gauges would be made from it, without reference to the unit. So I do not consider that for gunwork to come hereafter the metric system would be any more expensive than the present system.

So too for arms already in the market. Although they are designated by the calibre, in tenths and hundredths of the inch, the system of perfect gauges enables us to be indifferent as to the unit in which the calibre is expressed, when the translation is once made on the tools and gauges, and the change of unit of measure would only give us inconvenience were all the tools, gauges and arms destroyed, so that to replace them we would have to fall back upon drawings made with the foot as the unit of measure, when the dimensions given on the drawings would require translation into millimeters and tenths. This contingency cannot arise.

I am therefore of the opinion that the inconvenience of the adoption of the metric system would be very small in gun shops, so far as the manufacture of arms is concerned.

In the machine shop the inconvenience would be greater, for obvious reasons, but I presume this subject has been thoroughly discussed with the managers of such shops.

I believe that in gun shops the convenience of the use of the metric system would more than compensate for the temporary inconvenience caused by its introduction.

Respectfully yours, W. B. FRANKLIN.

SAML. S. GREELEY, C. E., Chairman Committee on Metric System.

PAPER CONTRIBUTED BY J. B. MC CLURE, CHICAGO.

In addition to the ordinary measurements of time, space and mass, the measurement of force enters largely into the labors of the Engineer and Physicist. Force is defined to be whatever produces or tends to produce, change in the shape of a body as to rest or motion; and the unit of force, the so called absolute unit is the amount which produces in the unit of mass, unit velocity in the unit of time. If we take the second, foot, and pound as the units of time, space, and mass respectively, then the unit of force will be represented by the amount of force which generates in one pound a velocity of one foot in one second. In the units adopted by engineers the pressure exerted by gravity in a mass weighing one pound, the ideas of time and space are not explicitly contained but they are replaced by the complete ideas of pressure and gravity. Our unit, moreover, is a variable quantity depending on locality. It decreases with decrease of latitude and with a certain coefficient of safety, would at the equator carry the same load with a larger coefficient of safety. Inconvenience has arisen to Engineers from this variability inasmuch as the strength of the most homogeneous material used in engineering works varies in parts from the standard strength more than gravity at any place varies from its extreme limit on the earth's surface, but it is desirable that the definition which form the basis of a science should be expressed in the simplest possible terms, and it is especially desirable that these terms should not be more complex than the thing we wish to define.

The definition of force given above is, I believe, due to Newton. Since his time the modes of operation and the relations of a large number of forces have been investigated, and the important principle of the conservation of force established. It will be seen that heat, light, gravity, friction, chemical combination and certain combinations of the electric elements, current resistance, electric motive force, etc., are embraced in Newton's definition. Now the question arises, can we measure these forces as we measure gravitation by reference simply to the fundamental units of time, space and mass. The answer is furnished by the following statement included in the principle of the conservation of force. If by any process, we can completely convert a certain amount of one form of force into a definite amount of another form of force then by inverting the process we can completely reproduce the first in its original form and quantity from the second. The two things are equal, and the same units which apply to the measurement of one, apply to the measurement of the other.

Since chemical combination, heat and mechanical work are inter-convertible, we may infer at once that their units of measurement will include the same units of time, space and mass in the same functional form. The dimensions of the unit of mechanical force are a mass, multiplied by a length, divided by the square of a time or $\frac{L\,M}{T^2}$ if L represents the unit of length, M the unit of mass and T the unit of time.

The dimensions of work are a force multiplied by a length or $\frac{L^2\,M}{T^2}$. The following equation expresses a well known electrical law, giving the relations between electric current resistance, and mechanical work, $W = C^2\,R\,T$. A simple inspection of this equation shows as that the product of resistance into a time into the square of a current can be expressed in dimensions $\frac{L^2\,M}{T^2}$. Another equation not involving resistance gives the square of a current as a mechanical force of dimensions $\frac{L\,M}{T^2}$ and combining these equations we have $R = \frac{L}{T}$

In the year 1861 a committee of the British Association was appointed to determine the most convenient unit of electric resistance and the best form and material for the standard representing that unit. They finally chose as their unit of resistance one of the form given in equation above adopting 10,000,000 metres as the value of L and one second as the value of T. The labor of the committee extended through seven years, during which time they determined not only the unit of resistance, but the quantitative relations of all the elements of electrical science.

The question as to whether their final results were to be expressed in feet and pounds, or in metres and grammes came up for discussion and was decided in favor of the French measures. This decision virtually settled the matter for the physicists all over the world, and as an argument for the intrinsic merit of the metric system I know of nothing stronger than that the members of this committee, representatives of a nation obstinately attached to its traditions, engaged in the measurement of relations of which they were largely the discoverers, should quietly abandon the measures used in their life work and accept the standards of their hereditary rivals.

Concluded report of the May Meeting of the Civil Engineers' Club of the Northwest.

Analysis of James B. Eads' New Arch.

BY D. W. BOWMAN, C. E., SOUTH PASS JETTY WORKS.

(Written for Engineering News.)

In June 1874, Capt. Jas. B. Eads, in a paper read before the American Society of Civil Engineers, described a new design for arched-bridge construction.

The remarkable development and improvements made in the construction of iron bridges which has been the result of the energy and thoroughness of American Engineers, has occurred mostly in parallel chord trusses for short and medium length spans, and even for spans of a length which, a half century ago, had never been attempted, and in the use of the suspension system for spans of extreme length, which commerce has demanded, beyond the economic or engineering limits of the truss.

In upright arches, the only notable example in the United States for great spans is the St. Louis steel arch.

Various modifications of the suspension system have been constructed; as the straight link suspension, suspended girder and other plans, all designed to brace and stiffen the catenary under a moving load. The changes of form arising from changes in temperature and in loading, make it impossible, however, to unite the suspension with any other system, on any plan hitherto known, so that they will act harmoniously together, and in all these combinations, except under the normal conditions for which the calculations were made, the different systems act, to a certain extent not only independently of, but even contrary to, each other.

The suspension and arch systems have this fault in common, the difficulties in economic bracing being, however, greater in respect to the arch, since while in the suspension a considerable oscillation is possible within the limits of safety, in the arch an equal change of form might be fatal, and while the weight of the structure, in the *arch*, tends to increase any distortion, in the *suspension* it resists it more and more as the distortion increases.

On the other hand, the great saving of the arch in avoiding the towers, the anchorages and the shore spans gives it decided advantages over the suspension form.

In the construction of the St. Louis Bridge these difficulties attracted the attention of Capt. Eads, and the result of his study is given in the design which is the subject of this article. Various approaches have been made, both in this country and in Europe, to this system, but until Capt. Eads in the United States, and F. Claxton Fidler in England, took out their patents, the principle upon which these designs are based, was untouched. The plan of Capt. Eads consists in bracing an arch, jointed at the ends and at the center, by inverted arches on the under side, running from the

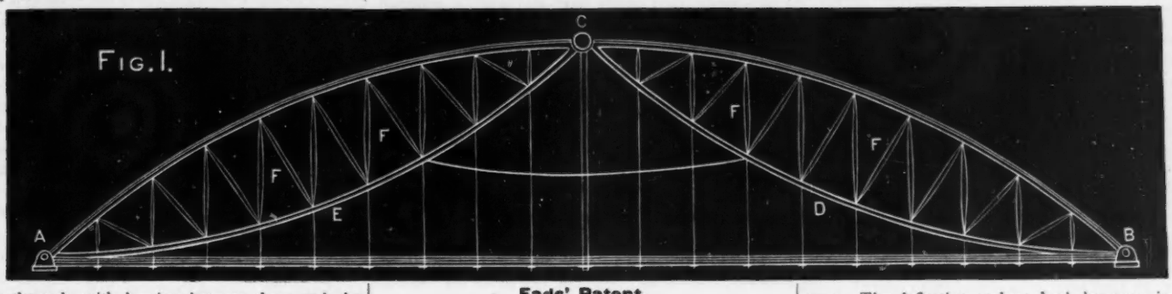

FIG. 1.

centerto the ends with bracing between these and the arch in the lenticular spaces thus formed. Fig. 1 shows the general principle of construction. The arch A C B is jointed at A, C and B, A E C and C D B are the counter arches, F F F the bracing. While the invention of Capt. Eads was the result of a study of the best means of bracing the arch, that of Mr. Fidler, though based upon the same principle, was reached in endeavoring to secure the same end for the suspension system. Each consists in jointing the sustaining member at the ends and at the center, and in bracing it on the *concave* side against unequal loading. Fig. 2 shows Mr. Fidler's design for suspension bridges, and inverted it is applicable as well for upright arches. Instead of a continuous arch across the entire span, it is composed of two arches meeting at the center and tangent at that point to straight lines leading to the points of support. Thus the curve A E C is tangent at C to the line C B. This

Eads' Patent.

design modifies the strains as found in the Eads plan, but on comparison the two forms are found to be of equal economy. In either system the internal bracing admits of various modifications. That given in Fig. 1 is believed to be the best, as it is the simplest, and it gives peculiar results in the relations of the amounts of strain in the different parts. The arch is a parabola with vertex at C, and the counter arches semi-parabolas with vertices at A and B.

It is evident that the design can be used as an arch or as a bowstring girder, according as the conditions make one or the other more economic. As an arch with fixed ends there is a vertical movement of the crown under varying temperature while in the bowstring girder there is none, since in the latter the longitudinal expansion of the tie allows a movement of the ends of the arch sufficient to prevent the vertical movement of the center of the arch, and the whole structure acts as an ordinary truss. The deflection under a load, however, is much less in the arch than in a bowstring girder or in an ordinary truss, because of the extension of the tie in the latter under the increased strain. The changes of form under varying loads and temperature affect the strains in the different parts of the structure, no more than the same cause does in a parallel-chord truss. Such strains as are endured in the continuous ribbed-arch by varying conditions of temperature are impossible here, as the central joint allows free play to the two halves to accommodate themselves to these changes. The arch in reality consists of two inclined girders of varying depth, resting against each other at the center. The only strain that can be transmitted from one to the other, under any possible conditions of loading, is a thrust in the direction of its central line, from the center to the abutment. All uniform loads are carried directly by the arch, as in any other arch, without strain in the bracing except the ten-

FIG. 2.

sion in the vertical members which sustain the load. As the dead load far exceeds the live load in long spans, and is several times as great in the longest bridges designed, a system which carries it so directly to the abutments, with the use of so few parts, possesses marked advantages. In the ordinary truss nearly as many parts are strained by the dead as by the live load.

It will be seen by reference to the diagram that the longest member in the bracing of this arch, is exactly one half the rise of the arch in length. The longest member is at the center of the lenticular truss; the remaining ones diminish rapidly in length towards either extremity. In the rectangular truss, except a double system of bracing be adopted, each of the compression members in the bracing is equal in length to the height of the truss. The economic depth of the arch is consequently far greater than that of the truss, and is not limited by considerations regarding the interior bracing.

Fig. 3 is a diagram showing on one side the strains caused by a moving load of one ton per foot and on the other the strains from moving load of one ton and dead load of 1500 lbs. per foot, in a 350 feet span of 70 feet

Fidler's Patent.

rise. It will be seen that all the members except the arch, the tie and one or two verticals at each end, are subject to both tensive and compressive strains. No partial load causes a strain in arch or tie as great as that of a full load. (Fig. 3 will appear next week.)

The counter-arch receives no strain under a full load The maximum tension and compression in it are the same at any point. The ratio of the strains in the different parts of the counter-arch varies with the rise of the arch. For a versed sine equal to one fifth the span, the strain is nearly uniform throughout their entire length. When the versed sine is less than this, the strains in the counter-arches are greatest at the lower ends and diminish regularly towards the center of the arch. The conditions of loading which give the maximum strains in the counter arches are found from the equations

$$x = \frac{l x'}{\frac{l}{2d} y' + x'} \quad \text{and} \quad x = l - \left\{ \frac{l x'}{\frac{l}{2d} y' + x'} \right\}$$ when x=length of the load extending from end of span; l=length of span, d=depth of span=$\frac{l}{5}$; x' and y'=co-ordinates of points of rotation for counter-arch (or of panel points of arch) referred to A as center. The first value gives loading for maximum *tension*; the second, measured from opposite end of arch, for maximum *compression*. Both values together are equal to l; that is, the complement of the load which produces maximum tension in any place, produces maximum compression at the same place.

The maximum tension in the end panel at the left in the diagram is produced by a load extending from A nearly ⅕ the length of the span, and maximum compression by load from opposite end of span ⅗ its length. As the panels approach the center, the length of load for maximum tension increases, and for maximum compression decreases, until at the panel adjacent, to the center each is caused by about one-half load, the central panel load producing compression only. With the above ratio of $\frac{l}{d} = 5$, the strains in the counter-arch are about ⅓ of the average of the strains in the arch caused by same live load. Assuming that the dead load for a structure of this span would be ½ of live load, the strains in the counter-arch would be two ninths of the entire strains in the arch, and the amount of material required for it, remembering that it must be both a tension and compression member and allowing for this, would not exceed ¼ that required for the arch. In longer spans where the ratio of dead to live load is greater, this proportion would be still less.

(TO BE CONTINUED.)

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CEO. H. FROST, - Editor and Publisher.

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and of the
Chicago Chapter of the American Institute of Architects.

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PROPOSED DETROIT RIVER TUNNELS.

A more satisfactory means of communication with Canada than is afforded by a steam ferry has been desired for some years by the railroads which converge at Detroit.

The number of vessels which pass through the Detroit river in the season of navigation is extremely large. Hence the project of building a bridge with a draw meets with very decided opposition from the shipping interest. Both the ports on the upper lakes and those upon lake Erie, as well as all the country tributary to them, would be seriously affected by any impediment to navigation. By actual count the passage through the straits connecting the upper and lower lakes have averaged 42,000 a year for the last five years, nearly three times as many as by Sandy Hook and Hell Gate. For six months in the year there is, on an average, the passage of a vessel through those straits every four and seven-tenths minutes. Besides, many of the vessels come down in tows, which can only be held in check, in case a draw were closed, by swinging them completely round, so that the tug shall draw up stream, or by singly coming to anchor, an operation which would break up the tow. As these tows succeed each other rapidly , the obstacle of adraw closed for a train would cause serious trouble. Under these circumstances, the impracticabilities of a draw are manifest.

It would be possible to build a bridge high enough for vessels to pass under, but the headway below the bottom chord would have to be at least one hundred and thirty feet; the board of U, S. Engineers say that one hundred and fifty feet, with clear spans of four hundred feet, is necessary in order that the bridge shall present no decided obstacle to navigation, and they are inclined to think that the water traffic is much more important than the railroad traffic which crosses the river. The shores are, however, so low that the approaches necessary, in order to gain the elevation with practicable grades, will be expensive enough to put this bridge out of the question. An effort has been made during the present session of Congress to obtain an act sanctioning a bridge, but the prospect of success, either now or later. is very little,

The only other alternative is a tunnel. One was reported upon in January, 1869, by E. S. Chesbrough, C. E., of Chicago, and declared feasible. It was proposed to cross the river rather obliquely opposite the city of Detroit and unite the Michigan Central railroad with the Great Western railroad. The tunnel would be about 8000 ft. long, 3000 ft. lying beneath the river, with a maximnm grade of 1 in 50. The material to be excavated was shown by the borings to be a stiff clay with some boulders, and the roof of the tunnel was to be 20 ft. below the bottom of the river. Work was begun in December, 1871, upon the shafts, and from them were pushed out drifts or drainage tunnels for several hundred feet, when, after repeated irruptions of sand and water—which latter was, we believe, decided to come from other source than the river—the work was discontinued. Like the officer of Wellington's army, on the march to attack a strong fortress, who was told that its capture was impossible, and who replied—"not at all, for I have the Duke's order in my pocket,"—the engineer was ready to put it through if furnished with the sinews of war; its further prosecution was not impracticable, but was not thought judicious at that time by the railroad authorities.

The Canada Southern Railway Co., which has a bridge from the American shore to Grosse Isle, a point on the river some fifteen miles below Detroit, and thence to Stony Island, failing to obtain authority to bridge the main channel, have been forced to content themselves with a steam ferry. They have also recently perfected plans for a tunnel at that place. The formation is limestone, and the project seems very reasonable. The tunnel proper would start from Grosse Isle, in order to get the necessary grades ; the portion below the river would probably be longer than that of the one opposite Detroit, but a shaft on Stony Island would give more working faces. The depth of water is from thirty-five to forty ft. at Detroit, but materially less at this lower crossing.

Another scheme is to put a bridge across, at the eastern line of the city of Detroit, to the lower end of Belle Isle, or what is marked on the charts Hog Island, thence to run lengthwise of the island, between two and three miles, to its head, and there to tunnel to the Canada shore. The length of tunnel, to cross nearly at right angles, is put at a little less than 3000 feet, and the depth of water is at the maximum thirty-three feet. The approaches can be open cuts, and the grade is stated as one in two hundred. The material to be excavated is supposed to be earth, probably clay as at Detroit.

Without an intimate knowledge of the localities it is impossible to judge of the relative advantages of the different positions, but the proposed tunnel for the Canada Southern Railway, through the limestone stratum, seems to present the least special difficulties.

TO CONTRACTORS.

ENGINEERING NEWS is the only journal published in in this, or in any other, country, that makes a specialty of advertising "Proposals for Contracts". In pursuance of our intention to publish an American Engineering *newspaper*, we were led to insert a few of those advertisements, taken from Chicago journals, for the benefit of such of our readers as were engaged in the general business of contracting, and were soon made aware of the fact that it was a specially attractive feature to most of our subscribers. As rapidly as possible, therefore, we have extended the list of "Proposals" until they have begun to encroach seriously on the other columns of reading matter. We hope ere long, however, to add to our pages and in so doing we will, as the season of activity in public works advances, still farther enlarge our list of "Proposals for Contracts" until it will represent as far as possible the activity that may prevail in Engineering and Architecture throughout the whole country. Until further notice these "Proposals" are published *free*. The labor and expense of preparing the present list is considerable. They are obtained from engineers in various cities and from an exchange list of over three hundred daily and weekly papers, and have mostly all to be carefully revised and cut down to the fewest possible words, and the convenience of such a list, brought together from so many sources, has been widely appreciated by contractors and manufacturers throughout the country at large.

We are making special efforts to obtain the very latest and most reliable information of the opening of bids and the letting of contracts, and we here ask as a special favor that those of our subscribers as have access to such information will, as soon as possible, mail it to us for publication, being careful to send us only such matter as they *know* to be strictly accurate. We also solicit from manufacturers, intelligence relating to their products, and illustrative of the industrial progress of the country. We solicit also intelligence relating to engineering and architectural work of whatever nature, projected or in process of construction, so that our columns may represent, as far as possible, what is being done in those professions, and what progress we are making towards "better days."

Contract Work.

(From Helps' Life and Labors of Thomas Brassey.)

Mr. Hawkshaw, the eminent English engineer, justly observes that 'with the commencement of the railway system began an age of great works, during which undertakings of far more colossal dimensions were rapidly projected, and to be as rapidly carried into execution. The extension of the railway system called for larger docks and larger harbors, and since the construction of the Liverpool and Manchester Railway the public works that have been executed in the United Kingdom alone far exceed all that has been done before.'

At first sight, it might appear that there was no need for the contractor. In early days, and perhaps we may say in comparatively barbarous times, great works were doubtless executed without the intervention of the contractor. He is an inevitable product of civilization; for inevitably, with civilization comes the division of labor. It is obvious that one the of main advantages of doing work by contract, and through the agency of a practised contractor, is that you command the knowledge and experience of a trained body of men, fitted for the especial work. Something of this kind is to be observed in great works which were executed before the word 'contractor' came into being. We know but little, comparatively speaking, of the construction of the grand cathedrals which have risen throughout the Christian world. But we are told by those who have most carefully investigated such matters—that bands of skilled workmen, chiefly Italians, were employed in these buildings who went from place to place, and were enabled to give instruction to the local workmen. This, in some measure, rccounts for the uniformity of style pervading certain periods of church architecture.

It might be said, that at first sight, it does not appear why those who have undertaken a great public work, should not execute it by means of their own officers ; but almost all experience show that this would not be a wise course. There are many reasons for this conclusion, and some of them are based upon much knowledge of human nature. If the projectors of the undertaking had to execute the work themselves, they would undoubtedly be seduced into frequent change of plan, from the very fact of their being masters of the situation. This may be seen in much smaller matters than public works. When a gentleman undertakes to build a house for himself, many are the changes he is induced to make during the building of that house, and large is the additional expense which it generally incurs.

The system of contracting for great works necessitates much forethought before commencing them, and, for the most part, a rigid adherence to the plans originally laid down.

It may serve to show the need and value of this system of contracting for great works, that it perpetually tends to extend itself. The great contractor finds it to his advantage to sub-let portions of his contract ; and these are again sub-let to smaller men, by which means individual skill and exertion are gradually developed to the uttermost. Perhaps in no way could this individual skill and exertion be more amply developed, and the merits of individual men be brought more prominently forward than by this system of contracting. Moreover, it developes the power of bearing responsibility, and tends to create masters out of men.

Thus far as regards the advantages to be derived from doing work by contract. It must, however, be remembered that there are limits within which this practice should be confined, and that there are cases to which it is altogether inapplicable.

The demands, for example, of Government are not of a nature to be wholly met by dealings with contractors. These demands are liable to be sudden, large, imperative, and indefinite. Hence Government will do wisely not to abandon their establishments. It must also be remembered, that by keeping up some of those establishments, they have, on a sudden pressure, some of the benefits of competition within their reach, and are not entirely at the mercy of what we may call the foreign element of contracting.

So, again, as regards matters in which taste and beauty of design enter, or where there is great probability of a change of plan, the system of contracting is not altogether admissable. Even as regards that instance which I took before, of a house built by a private individual for himself, there is considerable probability that the house

will be better built, at any rate more suitably built, for the owner, if it is not built by contract. But no one will contend that it is not likely to be an expensively built house.

Those works, however—whether devised by government, public bodies, or private individuals—of which the character is definite, and the time for executing them not imperatively short, are the works which it is most advisable to have executed by contract.

Now the construction of railways is work which exactly fulfils these conditions. It is very definite in character: it is not like the demand for arms, or other warlike material, which may be wanted by a Government at a very brief notice: and, in short, it is one of those products of labor, in which contract work may be most usefully employed. Accordingly, the contractor makes his appearance on the stage as he is imperatively required.

It may also be noted that, in carrying out works in foreign countries, great benefits has accrued both to those countries themselves, and to the country in which these projects originated, from the works being confided to contractors who carried hither and thither bands of skillful workmen; and who, indirectly, brought much profit to the mother contry, while gradually they instructed the natives of other countries in skilled labor, and made them more useful citizens than they were before. There are some parts of Europe where the condition of the whole laboring population has been permanently raised by the introduction of British skill and British labor in the execution of a particular work. And this would hardly have been the case, or at any rate would not so soon have been the case, but for the presence of the British contractor and his accompanying army of British workmen; bringing new tools, new modes of working, new methods of payment; and, in short, introducing an element of vigor and prosperity which could not have been so well introduced in any other way.

The United States Signal Service.

(CONCLUDED.)

(From the Detroit Post.)

Notwithstanding the efforts that have been made from time to time to thoroughly educate the public in all the more important particulars affecting their interest, which are connected with the daily reports of the signal service, much misconception still exists. Inquiry reveals the facts that the locations of the districts named in the daily probabilities are not generally known. It may be well, therefore, to state that in the forecasts of the weather the different parts of the country are designated as follows:

Maine, New Hampshire, Vermont, Massachusetts, Connecticut and Rhode Island as the New England States.

New York, New Jersey, Pennsylvania, Delaware, Maryland, District of Columbia and Virginia as the Middle States, and that part of these States lying east of the Alleghany Mountains as the Middle Atlantic States.

North Carolina, South Carolina, Georgia and Northern and Eastern Florida as the South Atlantic States.

Eastern Mississippi, Alabama and Northwestern Florida as the Eastern Gulf States.

Western Mississippi, Louisiana and Eastern Texas as the Western Gulf States.

Sometimes the South Atlantic States, Eastern Gulf, that portion of the Mississippi not included in the Eastern Gulf States, with Tennessee and Kentucky, are grouped together as the Southern States.

Lower Lakes mean Lakes Erie and Ontario, with adjacent territory.

Upper Lakes mean Lakes Superior, Huron and Michigan, with adjacent territory.

The Lake Region includes the Upper and Lower Lakes.

The Extreme Northwest includes that portion of Dakota lying west of the Missouri River and the Eastern portion of Wyoming and Montana Territories.

The Northwest means the country lying between the Mississippi and the Missouri Rivers.

The Southwestern States mean that portion of the Western Gulf States lying west of the Mississippi River and including Arkansas.

Pacific States include California, Oregon and Washington Territory. The Ohio Valley includes the belt of country about 200 miles broad from Pittsburg to Cario. The Upper Mississippi Valley includes the belt of country about 200 miles broad from St. Paul to Cairo. The Lower Mississippi Valley includes a belt of country 200 miles broad from Cairo to Vicksburg. Below Vicksburg the character of the country so changes that it is no longer described as a valley. The Missouri Valley includes a belt of country 200 miles broad from Fort Sully to St Charles, Missouri. The St. Lawrence Valley includes a belt of country 200 miles broad from Lake Ontario to the mouth of the St. Lawrence River. The extensions "from Missouri to Ohio," etc., etc., refer to areas reaching to and including the central portions of the States named. Thus a report "westerly winds extending from Iowa to Pennsylvania" would signify that those winds would be felt in the interior of those States as well as over the territory lying between them.

In "the coasts," etc, is included the land between the coasts and the parallel range of coast hills or Mountains. In Texas, Louisiana and Northern Florida a belt of land extending 100 miles inward would be included. The dividing line of the Upper and Lower Lake region passes through the city of Detroit, and predictions for either region alike affect it.

One of the most important duties performed by the signal office in this city is the display of cautionary storm signals. These are continued during the season of navigation only. They are displayed from the roof of Bank block, in which building is located the signal office, and are also duplicated, night and day, by Messrs Dunlap, Donaldson & Co., from their building, near the foot of Woodward avenue, The cautionary signal of the United States army—a red flag with a black square in the center by day, and a red light by night—signifies:

1. That from the information had at the central office, in Washington, a probability of stormy or dangerous weather has been deduced for the port or place at which the cautionary signal is displayed, or in that vicinity.

2. That the danger appears to be so great as to demand precaution on the part of navigators or others interested—such as an examination of vessels or other structures liable to be endangered by a storm—the inspection of crew, rigging, etc., and general preparations for rough weather.

3. It calls for frequent examinations of local barometers and other instruments by ship captains and others interested, and the study of local signs of the weather, as clouds etc.

By these means those who are expert may often be confirmed as to the need of the precaution to which the cautionary signal calls attention, or may determine that the danger is over-estimated or past.

The term dangerous wind has ordinarily a somewhat different meaning, according to the location of a station. Thus the severe gales of the Atlantic (where the hourly velocity of the wind ranges from 40 to 70 miles) are comparatively very rare on the lakes, where the limited sea room causes winds that on the neighboring shores are registered only as brisk (that is from 15 to 25 miles) to become dangerous.

Again, the direction in which the wind is blowing is a most important consideration, and, as general experience shows that most danger is apprehended from a wind blowing on a lee shore, the cautionary signal may very properly be expected to be hoisted only in case such winds are apprehended for the port in question. The cautionary signal is hoisted, however, when the winds are represented to be as strong as 25 miles per hour, and to continue so for several hours, within a radius of 100 miles of the station. It is thus left to the public individually to decide whether that wind will be dangerous to any special occupation. Each signal holds good for the space of about eight hours from the time at which it is hoisted, and in no case is such signal displayed by any observer except upon receipt of a telegraphic order to that effect from the central office at Washington. When no signal is displayed it indicates that the central office has no knowledge of any approaching danger, and as this is not only the case when there really is no danger, but also in many cases may be the consequence of the failure of the telegraphic connections of the central office at Washington with neighboring stations it should not lead the mariner or other interested party to be less watchful of the weather nor to neglect to obtain such weather intelligence as he may need to form accurate conclusions as to the nature of any impending danger.

In addition to the duties already spoken of there are many more of which time and space debar a mention. To the public it is desired to make the labors of the signal service a vital necessity, and in furtherance of this object no pains will be spared by those connected with the service to place before the people the results of their researches in the realms of science.

In the signal office are kept on file the daily weather reports, the weekly and monthly publications of the central office, yearly reports, compendium of facts, etc., etc., which are at all times accessible and to which the attention of the public is invited.

THEO. V. VAN HEUSEN, Sergt. Sig. Ser. U. S. A.

Notes on Steam Boilers.

There is no difference of importance in the tensile strength of boiler plates whether torn asunder in the direction of the fibre, or across it.

The strength of common boiler plate is materially affected by ordinary temperatures, but towards a dull red heat it is rapidly and very seriously deteriorated.

As regards the relative strength of riveted joints and solid plates, if we assume the strength of the plate to be 100, the strength of the double riveted joint, after allowing for the adhesion of the surfaces of the plate, would be 70, and the strength of the single riveted joint 56, and these proportions of the relative strengths of plates and joints may, in practice, be safely taken as the standard value, in the construction of vessels required to be steam and water tight, and subjected to pressure varying from 19 pounds to 100 on the square inch.

By experiment it is found that that the strength of the riveted joints of boilers is only about one-half the strength of the plate itself; but taking into consideration the crossing of the joints, 34,000 pounds may reasonably be taken as the tenacity of the riveted plates, or the bursting pressure of the cylindrical boiler.

The thickness of the plates of cylindrical boilers should be in proportion to their diameters.

A boiler constructed with plates of uniform thickness is most liable to undergo rupture in its longitudinal sections.

Let c=thickness of plate; d=internal diameter of boiler; P=pressure of steam in pounds per square inch; T=tenacity in pounds per square inch of the material; then $c = \frac{d\,P}{2\,T}$, and $P = \frac{2\,c\,T}{d}$, therefore for iron plates T being taken at 34,000 pounds, the required thickness in inches is equal to the diameter in inches multiplied by the pressure per square inch in pounds, and divided by 68,000; and the bursting pressure in pounds per square inch is equal to the thickness in inches multiplied by 68,000 and divided by the diameter in inches.

The following is a table of equal strengths in the external shell of cylindric boilers from 3 to 8 feet diameter, showing the thickness of metal in each respectively, for a bursting pressure of 450 pounds to the square inch:

Diameter of Boilers.		Bursting Pressure—equivalent to the ultimate strength of the riveted joint, as deduced from experiment, 34,000 lbs. to the square inch.	Thickness of the Plates in decimal parts of an inch.
Feet.	Inches.		
3	0	450 lbs.	.250
3	6		.291
4	0		.333
4	6		.370
5	0		.416
5	6		.458
6	0		.500
6	6		.541
7	0		.583
7	6		.625
8	0		.666

The strength of wrought iron tubes subjected to external pressure, varies *inversely* as their length, or of two flues perfectly similar in other respects, one 10 feet long is as strong as one 20 feet long.

The following is a table of equal strengths in the cylindrical flues of boilers from 1 to 4 feet in diameter, and from 10 to 30 feet in length, showing the requisite thickness of metal for a collapsing pressure of 450 pounds per square inch:

Diameter of Flues.	Collapsing pressure of flue in lbs. per square inch.	Thickness of Plates in parts of an inch.		
		For a 10 feet Flue.	For a 20 feet Flue.	For a 30 feet Flue.
Inches.	450			
12		.291	.309	.480
18		.350	.450	.578
24		.399	.548	.659
30		.442	.607	.730
36		.480	.659	.794
42		.516	.707	.851
48		.548	.752	.905

Flues should be as perfectly cylindrical as possible as any ellipticity reduces their strength very materially.

The amount of strain upon a high-pressure boiler 30 feet long, 6 feet diameter, having two centre flues, each 2 ft. 3 ins. diameter, working at a pressure of 50 pounds on the square inch, is 3,319 tons, and with the pressure at 450 pounds per square inch there is a force of very nearly 30,000 tons exerted, while in a locomotive working at 100 pounds to the square inch, there is pent up within its interior the enormous force of nearly 60,000 tons, a force which is still further increased at accelerated speed.—*Useful Information for Engineers.*

Contractors' Intelligence.

Wages were reduced 25 cents per day on the State Capitol Building at Des Moines, Iowa, on the 5th inst.

J. F. Wadworth, C. E., of Taunton, Mass., is at work on the surveys for the New Water Works in that city.

J. L. Bullard of Taylor's Falls, Minn, has the contract for the construction of the new Court House at Center City, Chisago County, Minn., at the price of $4,925.

The Wrought Iron Bridge Company of Canton, Ohio, are building two bridges, one 500 feet long for Columbus, Ohio, and the other 450 feet long, for Ottawa, Canada.

The contract for a new iron bridge, to cost about $10,000, over the Iowa River near Iowa City, has been awarded by the Board of Supervisors of Johnson County, Iowa, to the Canton Bridge Company of Canton, Ohio.

William White & Co., of this city, have the contract for furnishing the galvanized iron cornice, tin and slate roofing, etc., for the new Cook County Hospital building in process of erection in this city. The price is about $7,400.

The Architectural Iron Works of this city have the contract for, and are now engaged in furnishing, the entire iron work for the new Adams Co. Court House and Jail at Quincy, Ill. Lockworthy & Burge of Quincy are the general contractors for the construction ot the new building.

The contract for building 1000 feet of 24-inch diameter brick sewer, and 650 feet of 30-inch, including manholes, receiving and catch basins, and 400 feet of 12-inch tile, in the city of New Britain, Conn., has been awarded to Cranfield & Brennan, of New Haven, for the sum of $6,497.50. The bids were as follows: $8,878.10; $7,-921.60; $7,629.00; 6,497,50.

Stone setting was resumed on the new Capitol building at Lansing, Mich., last Monday. The work of furring and lathing has been progressing all the winter and spring quite favorably. Some of the workmen engaged in that are now in the third story. A great part of the material for heating the edifice has been received during the winter, including large iron tanks for feeding the boilers with water by hydraulic pressure.

The Board of Public Works of Chicago last week issued an estimate of $2,500 to Earnshaw & Gobel for masonry work on the tower for the stand-pipe at the West Side pumping-works. Estimates were also issued to the Keystone Bridge Company for work on the Halsted street viaduct; one for $4,250 for the Chicago & Northwestern railway's portion of the work; and another of $7,235 for the Chicago, Burlington and Quincy railway's share of the same.

At a joint session of the Boards of Selectmen of the Towns of New Haven and Orange, Conn., held on Thursday evening, May 4th, 1876, at City Hall, New Haven, proposals were opened for constructing an iron bridge, not including abutments, over West River between the two towns. The specifications called for a first class bridge of one span, 100 feet between centers of supports, 40 feet roadway in the clear, and a sidewalk on one side of 6 feet in the clear. Bids were received on the Engineer's plans, and also on the Contractor's plans. There were three plans prepared by the engineers, No. 1 being a bowstring bridge with vertical posts and adjustable diagonals, No. 2 a bowstring bridge with the Warren guide system of bracing, riveted to top and bottom chords, and No. 3 being a riveted straight truss bridge.

The proposals received on the engineers' plan were as follows:—

Cincinnati Bridge Co., Cincinnati, O.	$7150	$....	$6425
Delaware Bridge Co., New York City	7575	....	....
Keystone Bridge Co., Philadelphia, Pa.	7000	6970	....
King Iron Bridge Co., Cleveland, O.	6620	6570	....
R. W. McIntire, New Haven, Ct.	6831	6950	....

The proposals received from the bridge builders, on their own plans, were as follows:—

King Iron Bridge Co., Cleveland, O.	$....	$....	$....	$4650
Watson Man'f'g Co., Paterson, N. J.	6382	6214.75		5921.25
D. H. Andrews, Boston, Mass.	....	....	....	5985
Cincinnati Bridge Co., Cincinnati, O.	7000	6775	6380	6300
Wrought Iron Bridge Co., Canton, O.	....	....	7330	6525
Keystone Bridge Co., Phil'a, Pa.	....	....	....	6600
H. M. Claflin, Cleveland, O.	....	....	....	6600
A. D. Briggs & Co., Springfield, Mass.	....	....	6800	6600
N. J. Steel & Iron Co., Trenton, N. J.	....	....	....	6743
Hawkins & Burrell, Springfield, Mass.	....	....	....	6750
Penn Bridge & Machine Works, New Brighton, Penn.	....	....	....	8400

The proposals were referred to a committee of one member of each Board and the Engineers, to examine the plans, strain sheets, etc., and report at a meeting to be held Thursday evening, May 11th, 1876.

As we go to press, we are informed by telegraph, that no award was made at the meeting of the joint committee on the evening of the 11th.

PROPOSALS FOR CONTRACTS.

BRIDGE.—Bids will be received by the undersigned, at Clarinda, Iowa, until 2 P. M. June 6th, for building a Howe truss covered bridge, 100 feet span, across the Nodaway river, east of Clarinda. W. M. Alexander, Auditor.

BRICK.—Bids will be received at the office of the General Superintendent of the new capitol, Albany, N. Y., until 12 o'clock, noon, Monday, May 22d, for furnishing four millions of bricks required for this work. All bricks must be perfect; no arched, swelled, crooked or soft bricks will be received, and all will be subject to the approval of the Superintendent. No bid will be received for less than five hundred thousand. (See Albany Evening Times for further particulars.) James W. Eaton, Superintendent.

BUILDING STONE.—Bids will be received at the office of the Superintendent of the new capitol, Albany, N. Y. until 12 o'clock noon, Monday, May 22d, for furnishing the following material required for this work: 1,800 feet lineal of bond stone, 1 foot, 7 inches wide, from 2 and ½ to 3 inches thick, and each stone from 2 to 3 feet long. 1,300 feet lineal of bond stone, 2 feet and 7 inches wide, from 2 and ½ to 3 ins. thick, and each stone from 3 to 4 feet long. This may be Blue Flag stone or Potsdam sand stone. (See Albany Evening Times for further particulars.) Jas. W. Eaton, Superintendent.

BRICK SEWER.—Proposals will be received by the undersigned at Sioux City, Iowa, until 12 o'clock M, May 6th for the construction of a brick sewer from the present terminus of the Douglass street sewer on the north side of Fourth street, to a point on Douglass street opposite the alley running east and west through block 16. Sioux City East Addition; same to be built according to original plan of Douglass street sewer, which may be found with the city engineer. Each prososal must give price pr foot, payable in ten per cent city bonds running ten years, and price per foot payable in cash. Proposals may be sent to either of the undersigned. C, E, Hedges, P. R, Kennedy, C. F. Hoyt, H. H. Buckwalter.

CEMENT.—Bids will be received at the office of the General Superintendent of the new capitol, Albany, N. Y., until 12 o'clock noon, Monday, May 22d, for furnishing five thousand barrels of the best quality fresh ground hydraulic cement, required for use this work this season, to be delivered in such times and in such quantities as may from time to time be directed by the Superintendent. (See Albany Evening Times for further particulars. James W. Eaton, Superintendent New Capitol.

DREDGING—Bids will be received at the office of the Harbor Board, Baltimore, until noon, May 30, and opened immediately thereafter, for the excavation and removal of material from the inner harbor or basin of Baltimore. The right is reserved by the board to reject any or all proposals, and none will be entertained for less than 50,000 cubic yards, or more than 200,000 cubic yards. Specifications and any other information can be had by application to the office of the Harbor Board, City Hall, Baltimore, on and after May 16; By order of the Board. N, H, Button, Engineer.

GRANITE CUTTING.—Bids will be received at the office of the Superintendent of the new capitol, Albany, N. Y. up to 12 o'clock, noon, Monday, May 22d for cutting columns and moulded bases for the principal floor of this building, required for use this season. The stone is already contracted for. The plans, specifications and conditions may be inspected at the architect's office, 53 North Pearl street. (See Albany Evening Times for further particulars.) James W. Eaton, Superintendent New Capitol.

LIFE SAVING STATION HOUSES.—Proposals will be received at the Treasury Department in Washington, D. C., until 12 o'clock M, of Tuesday the 25th of May, for the construction of Life Saving Station Houses at the following named points on the coast of Lake Superior, to-wit: One at Vermillion Point, one at a place seven miles west of Vermillion Point, one at Two Heart River, and one at Sucker River, all in the state of Michigan. Bids will be received for one, several, or all of the above mentioned houses. and bidders must state the number they will build and designate the localities. Each bid must be accompanied by a bond in the sum of one thousand dollars, with two good and sufficient sureties, conditional that the bidders shall enter into contract without delay if his bid be accepted, All proposals must be indorsed, "Proposals for the construction of life-saving station houses, coast of Lake Superior," and addressed to the Secretary of the Treasury, Washington, D. C. Specifications and plans, and forms of proposal and bond can be obtained at the office of the Collectors of Customs at Detroit, Port Huron, Grand Haven and Marquette, Mich., Chicago, Ill. and Milwaukee, Wis. also upon application to this Department. B. H. Bristow, Secretary.

MASONRY AND BRICKWORK.—Proposals will be received by the undersigned, for foundation walls of stone and brickwork thereon, for the machine shops of the B. C. R. & M. R. R., at Cedar Rapids, Iowa. Plans and specifications can be seen at the office of the Engineer of the road, in Cedar Rapids where any information required will be furnished. E. F. Winslow, Receiver.

RAILROAD WORK.—Proposals will be received at our office in Dayton, O., for grading twenty miles of the D. & S. E. R. R. Profiles ready. Phelps, King & Co.

RAILROAD WORK.—Sealed tenders, addressed to the Secretary of Public Works and endorsed "Tender Pacific Railroad" will be received at the office of the Department of Public Works in Ottawa, Ontario, until 12 M., Monday, May 22d for the excavation and grading required to be executed on that section of the Canadian Pacific Railway extending from Cross Lake, eastward to Rat Portage, Lake of the Woods, about 37 miles in length; also for the grading required from the westerly end of the 13th contract to English River, a distance of about 80 miles; also for tracklaying and other work of construction west of Fort William. For plans, specifications, approximate quantities, forms of tender and other information apply to the office of the Engineer-in-Chief, Ottawa. No tender will be entertained unless on the printed form, and unless the conditions are complied with. By order, F. Braun, Secretary.

SCHOOL HOUSE.—Bids will be received at the Township Clerk's office of Coventry township, Summit Co., O. until 12 o'clock, M., May 27th for building a school house on the lot situated in sub-district No. 4 of said township, according to plans and specifications on file with the Township Clerk. The bids for each kind of material called for in the specification must be separately stated. By order of the Township School Board. A. Oberlin, Jr., Clerk.

STREET IMPROVEMENTS—Proposals will be received at the office of the City Commissioner in Baltimore until Thursday, May 18th, at 12 M., to repave all that part of Second Street between South and Gay streets, with "Camp's Belgian block pavement," as per ordinance No. 59, approved April 28th, 1876. The bids will be opened on the same day in the Mayor's office; bond with approved security will be required for the faithful performance of the work. John E. Toole, Clerk to City Commissioner.

STONE CARVING.—Bids will be received at the office of the Superintendent of the new capitol, Albany, N. Y. up to 12 o'clock noon, Monday, May 22d, for carving column caps in granite for the principal floor of this building, required for use this season. The stone is already contracted for. The plans and specifications and conditions may be inspected at the architect's office, 53 North Pearl street. (See Albany Evening Times for further particulars. James W. Eaton, Superintendent New Capitol.

SCHOOL HOUSE.—Bids will be received at the office of the Clerk of the Board of Education of Springfield township, Summit Co., O., until 12 o'clock M., on Tuesday, May 30th, for building a school house on the lot situated in sub-joint district No. 7 in said township according to plans and specifications on file in said office. The bid for each kind of material called for by the specifications, must be separately stated, and the price of each stated, and the price of labor must also be stated separately. By order of the Board of Education. Thos. J. Gilcrest, Clerk.

SCHOOL HOUSE.—Bids will be received at the Township Clerk's office, Youngstown, Ohio, until 12 M, May 27th, for a school house at Brier Hill, known as sub-district No. 3, in the township of Youngstown. Separate bids will be received for the masonry, carpenter work, plastering and painting, or bids will be received for the whole job; but such bids must be made for the several portions in detail; plans and specifications may be seen by applying to Andrew Shaffer, Township Clerk, at his office. Building Committee.

STATE REFORM SCHOOL.—The trustees of the Iowa Reform School hereby give notice that they intend to erect a main building for said school, and will receive bids for three hundred thousand or more brick of best quality, delivered in Eldora. Two hundred or more legal perch of best quality foundation stone, delivered at Eldora or at quarry, also the price per m. of the various kinds of lumber necessary for such building, all to be delivered as above. All bids will be addressed to E. Andrew, Eldora, Iowa, and will be received until May 31st, at which time they will be opened and examined. J. A. Parvin, president. T. E. Corkhill, secretary.

SCHOOL HOUSE.—Bids for the erection of a school house for the Independent district of Logan, Harrison Co., Iowa, accompanied by plans and specifications of the same will be received and contract let at the school house in said district, May 27th, at 1 P. M. No plans and specifications will be received which are not accompanied with a bid to erect the same. Said school house is to be built of brick, with stone foundation, to be two stories high, and to be heated by furnace, and to be sufficient in size to seat at least two hundred pupils, the cost of said building not to exceed $5,000. W. H. Davis, G. B. Cadwell, D. S. P. Michael, Directors.

SCHOOL HOUSE.—Proposals will be received by the Board of Directors of the Independent School District of the city of Burlington, Iowa, for the erection of a two-story addition to the "West Madison" School House, until 9 o'clock, A. M. of May 20th, 1876, according to plans and specifications which will be ready for inspection at the office of the Secretary, in Parson's block, on and after April 25th. Separate bids will also be received for window blinds for the whole building. All bids must be signed by the party proposing to do the work, securely sealed, and endorsed, "Proposals for erecting West Madison addition," or "Proposals for blinds." and delivered to the Secretary before the hour above fixed. By order of the Board. Geo. Frazee, Secretary.

SCHOOL HOUSE—The Board of Education of Jefferson township, Franklin county, Ohio, hereby invite bids in accordance with section 54, Ohio School Laws, for the building of two school houses in said township, on the sites now occupied for school purposes in sub-districts Nos. 4 and 8. Specifications: Size, 24x32 feet; walls brick, good quality, 13 inches thick, 12 ft. story above foundation; foundation to be of good stone and extend not less than 2½ feet above the surface of the ground, and to be not less than 20 inches thick, with center wall 12 inches thick, well laid in mortar. Each house to have two doors (state price of one) with transom light above, and 3 well proportioned windows on each side of the house in box frames, with pulleys; the finish to be plastering and wainscoting. The wainscoting to be put on after one coat of plastering from the floor to the base of the windows. The walls to have three coats, the last one hard finish. With seats of an approved make and pattern; first-class pine shingles to be used in roofing, with 15 inch cornice; all lumber to be first-class. The old houses are of brick; size of one in sub-district 4, 20x26 feet; in sub-district 8, 20x24 feet, with 8 inch wall, and 9 feet story, on stone foundation. The material in these must be taken into account, and used as far as practicable in the construction of the new houses. Bids will be received at the office of the Township Clerk until June 3d at which time they will be opened. Any other information may be had by applying to E. Dryer, Gahanna, or H. J. Rhodes and J. W. Sagar, Black Lick, committee.

STATE PENITENTIARY.—The undersigned commissioners under an act of the State of Texas, approved February 9 hereby advertise for proposals of plans, specifications and other particulars for the proper and substantial building and completion of two penitentaries in said state in conformity to the modern forms of constructing public prisons, which have proven to be the best for the health and comfort of the convicts. One of said penitentaries to be built about two miles north of Rusk, in Cherokee county, with a view of utilizing in manufactures the iron ores which abound in this section of the state; the other to be built at the head of the San Marcos River, in Hayee county, contemplation of the manufacture of cotton, wool, leather and other goods and fabrics, that will not come into competition with the personal industries of the mechanical professions. Said penitentaries are to be completed by the first day of July 1877, and parties making proposals of plans, etc., for both, or either of said penitentaries, will state upon what terms and for what amounts they will build the same, and will, in connection with said proposals, furnish due guarantees of their abilities to build and complete the same in accordance with such plans, etc., and by the time limited. Persons desiring to inspect the sites indicated will call on E. L. Gregg, at Rusk, or Gen. Ed. Burleson at San Marcos, and all proposals will be addressed to E. L. Gregg, at Rusk, Cherokee county, Texas. The commissioners expressly reserve the right to reject any and all proposals, and hereby give notice that no compensation will be made for any proposals, plans, etc., which may be submitted under this advertisement. W. W. Lang, Ed. Burleson, B. W. Brown, E. L. Gregg, Commissioners.

WATER WORKS.—City Council of Peoria, Ill. invite bids, accompanied with plans and specifications, for building a filter bed at the water works. Bidders will state the plan of filtration proposed, the size and shape of bed, and nature of materials they propose to use. Bids to be left with the city clerk on or before May 24, 1876. Chas. H. Kellogg, Thos. J. Kelly, John P. Cress, Water Works Committee.

WATER WORKS.—Bids will be received by the Common Council of Ft Wayne, Indiana, at the office of the City Civil Engineer for the construction of the Fort Wayne water works, and embracing the following particulars: For two sets of steam pumping machinery, each capable of raising 15,000,000 gallons of water 200 feet high in 24 hours. For one steam pumping machinery capable of raising 3,000,000 gallons of water, 200 feet high in 24 hours. For one water wheel and pump of the same capacity. For furnishing and laying 22 miles of water pipes, with all the necessary fire hydrants, stop gates and special castings. For the construction of two filtering basins. For the erection of a stand pipe and tower 200 feet high, and for the construction of an engine house and boiler house. Also, for furnishing all other structures and appurtenances required, as per plans and specifications. Proposals will also be received for furnishing a sufficient supply of water for domestic use, and for the extinguishment of fires; and also for water power to pump the same into pipes. The prices must be written in the bid, and also stated figures. Bidders are required to state in their proposals their names and places of residence. Each proposal will be accompanied by the undertaking in writing, of two responsible persons, with their respective places of business or residence, to the effect that if the contract be awarded to the person or persons making the bid, they will, on its being so awarded, become bonnd as sureties for its faithful performance; and if he or they shall omit or refuse to execute the same, they will pay the city of Fort Wayne any damage that may be occasioned to the said city by such failure; the plans and specifications can be seen at the office of the city civil engineer, and proposals will be received for the entire work, or any part of the same until Tuesday, May 23d at noon. John Ryall, City Civil Engineer.

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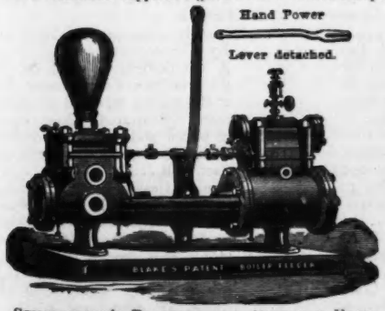

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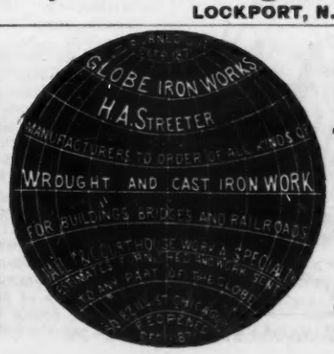
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